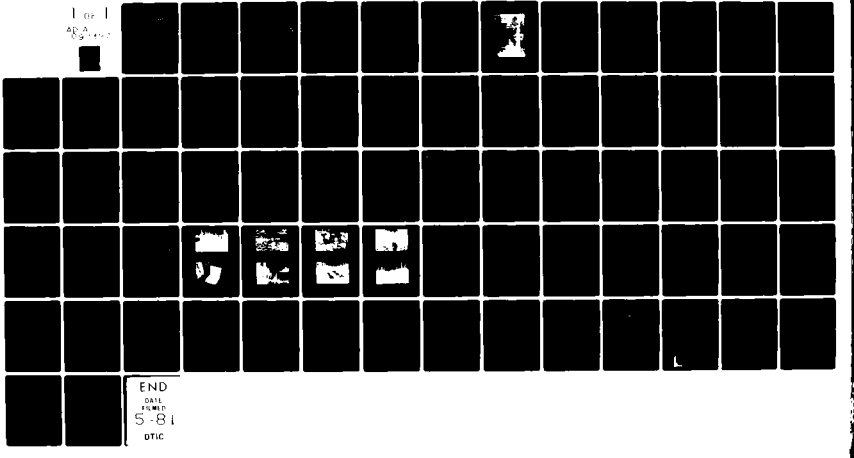
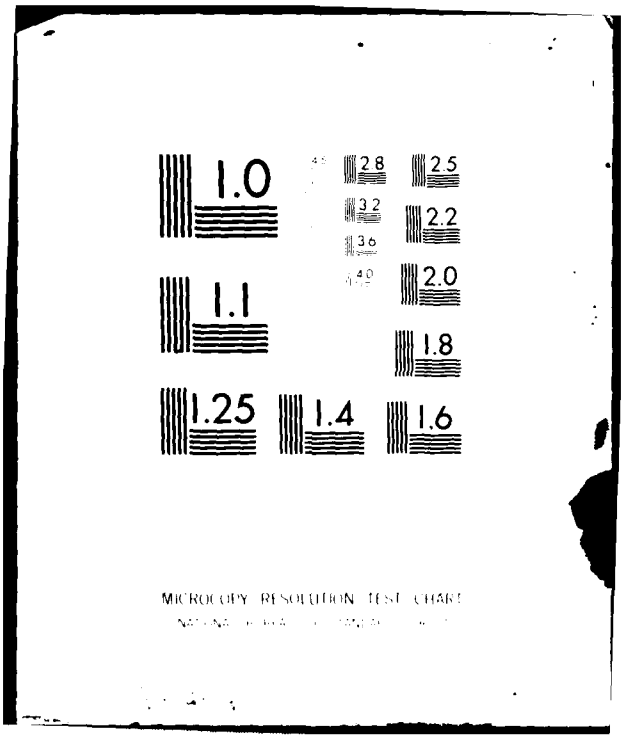
AD-A097 397 O'BRIEN AND GERE ENGINEERS INC PHILADELPHIA PA F/G 13/13
NATIONAL DAM INSPECTION PROGRAM. SOLEBURY FARM DAM (NDI ID PA-0--ETC(U)
FEB 81 DACW31-81-C-0016

UNCLASSIFIED NL

1 OF 1
AD A 097 397



END
DATE FILMED
5-81
DTIC


1.0
2.8
2.5
3.2
2.2
3.6
2.0
1.1
1.8
1.25
1.4
1.6
MICROCOPY RESOLUTION TEST CHART

DELAWARE RIVER BASIN
HONEY HOLLOW CREEK
PENNSYLVANIA

NDI ID PA-00944

PA DER 9-152

AD A097397

LEVEL II

SOLEBURY FARM DAM

OWNED BY

~~SOLEBURY FARM JOINT VENTURE~~

PHASE I INSPECTION REPORT.
NATIONAL DAM INSPECTION PROGRAM

(15) DACW31-81-C-0016

DTIC ELECTE APR 7 1981

PREPARED FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

BY

O'BRIEN & GERE

PHILADELPHIA, PENNSYLVANIA
19103

FEBRUARY 1981

81 4 6 071

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

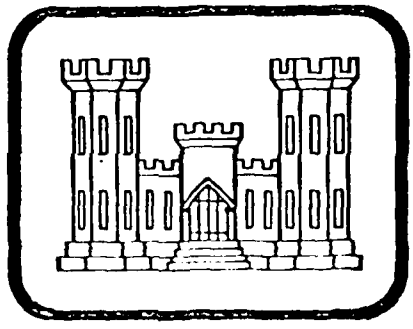
DELAWARE RIVER BASIN

SOLEBURY FARM DAM
PENNSYLVANIA

NDI ID PA 00944

OWNED BY
SOLEBURY FARM JOINT VENTURE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



Prepared for:

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

Prepared by:

O'BRIEN & GERE ENGINEERS, INC.
1617 JF Kennedy Boulevard - Suite 1760
Philadelphia, Pennsylvania 19103

FEBRUARY 1981

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected, and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

Name of Dam:	Solebury Farm Dam
State Located:	Pennsylvania
County Located:	Bucks
Stream:	Honey Hollow Creek
Coordinates:	Latitude 40°22.1', Longitude 74°59.2'
Date of Inspection:	December 15, 1980

ASSESSMENT

Solebury Farm Dam is an earth embankment about 150 feet long with a maximum height of approximately 27 feet. The structure was completed in November, 1953 for recreational purposes. The dam and impoundment are currently owned by the Solebury Farm Joint Venture.

Solebury Farm Dam has a maximum storage capacity of 121 acre-feet and a height of 27 feet. The dam is classified as "Small" size. Because of the chance for excessive property damage and loss of more than a few lives in the potential damage area, about one mile downstream, the dam is considered to be a "High" hazard structure.

Examination of the results of the hydrologic and hydraulic analyses indicates that the spillway is capable of passing approximately 18 percent of the Probable Maximum Flood (PMF) without the dam being overtopped. The selected Spillway Design Flood (SDF) for this "Small" size, "High" hazard potential structure is fifty percent of the PMF. The water surface elevation at the damage center is 1.0-foot higher for the breach condition than for the non-breach condition. The spillway is classified as "Inadequate", since it is not capable of passing the SDF; however, it is not classified as "Seriously Inadequate" since breaching of the dam does not significantly increase the downstream hazard potential.

Based on visual observations and a review of the information obtained from the Pennsylvania Department of Environmental Resources, Solebury Farm Dam appears to be in fair condition.

Recommendations and Remedial Measures

The following recommendations and remedial measures should be initiated immediately. The Owner should retain the services of a licensed professional engineer experienced in the design and construction of dams to assist in complying with these recommendations and remedial measures.

a. Facilities.

1. A detailed hydrologic/hydraulic study should be performed to determine the best method of increasing spillway capacity to make it hydraulically adequate.

2. The embankment should be cleared of all trees and brush and any resulting voids should be backfilled with suitable compacted material. A grass cover should be established and maintained on the slopes and crest of the dam.

3. An investigation should be made to assess the source and nature of seepage observed near the spillway outlet channel.

4. The control valve should be restored to an operable condition. Measures should be taken to insure that the control valve is accessible for all flow conditions. Provisions should be made for emergency closure of the outlet pipe upstream of the steel cut-off.

5. Riprap should be placed on the upstream face of the dam to protect the embankment from wave action.

6. The masonry retaining wall and access manhole should be repointed to limit deterioration. The ladder rungs in the manhole should be inspected and repaired if necessary.

7. The spillway should be cleaned of all debris. The flashboard system and trees growing in the spillway should be removed.

b. Operation and Maintenance.

1. A formal maintenance and inspection program should be developed and implemented to insure that the dam and appurtenances are maintained on a regularly scheduled basis. Maintenance performed should be recorded to provide a history of corrected deficiencies.

2. A downstream warning system should be developed. During periods of heavy rainfall, the dam should be monitored and appropriate agencies should be alerted in the event of an impending failure.

O'BRIEN & GERE ENGINEERS, INC.

John J. Williams, P.E.
Vice President
Pennsylvania Registration No. PE006920E

Date: 13 FEB 81

Approved
JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date: 4 March 81

OVERVIEW
SOLEBURY FARM DAM, BUCKS COUNTY, PENNSYLVANIA

TABLE OF CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
SOLEBURY FARM DAM
NATIONAL ID NO. PA 00944
DER # 9-152

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project (This description is based on information obtained from the Pennsylvania Department of Environmental Resources (DER), Division of Dam Safety, Harrisburg, Pennsylvania and from the field inspection.)

a. Dam and Appurtenances. Solebury Farm Dam is an earth embankment approximately 150 feet long with a maximum height of 27 feet. An ungated overflow spillway approximately 30 feet long, is constructed at the left end of the embankment and extends into the rock at the left abutment. A stone masonry wall about 8 feet high is constructed to retain the embankment along the right side of the spillway.

The dam, which is located at the eastern end of the impoundment, has a crest width of about 20 feet. The upstream and downstream faces of the embankment are constructed on slopes of 3H:1V and 2H:1V, respectively. The embankment material is reported to be loam which was available on site. A steel sheet was placed along the axis of the dam as a cut-off. The sheet extends from the foundation to within six inches of the crest. According to design drawings, the original ground was excavated to bedrock before embankment material was placed.

The spillway is excavated in rock and is located so that natural rock forms the left sidewall and invert of the spillway. The approach and discharge channels of the spillway are on slopes of approximately 25 percent.

The material used for the cut-off is "0.25-inch copper bearing firebox steel welded into one solid piece from end to end of dam and protected with 2 coats of red lead or one coat of red lead and one coat of asphalt." The sheet is supported at the base by a concrete footing founded on bedrock.

A 20-inch diameter cast iron pipeline (bell and spigot) is constructed through the embankment for use as a reservoir drain. The line is encased in 6 inches of concrete for its entire length. A 20-inch diameter gate control valve is installed on the line about 3 feet downstream of the steel cut-off wall. A stone masonry

manhole, about 4 feet in diameter is constructed from the dam crest to provide access to the valve.

b. Location. Solebury Farm Dam is located on Honey Hollow Creek in Solebury Township, Bucks County, Pennsylvania. The dam and impoundment are shown on USGS Quadrangle sheet entitled "Lambertville, PA-NJ". (7½ minute series) at coordinates N40°22.1', W74°59.2', approximately 2 miles west of New Hope, Pennsylvania. A regional location plan of Solebury Farm Lake is included as Figure 1, Appendix E of this report.

c. Size Classification. Solebury Farm Dam is about 27 feet high and has a maximum storage capacity of 121 acre-feet. The dam is therefore classified as a "Small" size dam (height less than 40 feet, storage less than 1,000 acre-feet).

d. Hazard Classification. One inhabitable dwelling and a restaurant are located about 1 mile downstream of the dam. The dam is therefore classified as a "High" hazard structure due to the potential for loss of life and excessive property damage.

e. Ownership. The dam is owned by Solebury Farm Joint Ventures. All correspondence should be directed to Parke Wetherill Associates, Inc., W. State and W. Court Streets, Doylestown, PA 18901, Attention: Mr. R. Stanley Cornell (Phone: (215) 348-3508).

f. Purpose of Dam. The dam was constructed to provide a lake for recreational purposes. The lake continues to be used for recreational purposes.

g. Design and Construction History. The dam was designed by the Campbell Water Wheel Co., Philadelphia, PA in 1946 with revisions made through 1947. The Permit for Construction was issued on July 15, 1947, to Mr. Lowell M. Birrell, the original owner. Construction of the dam was initially scheduled for completion by January 1, 1949.

The results of a State review of the original design included recommendations for a more efficient spillway weir, a more effective procedure for compacting the earth fill, increasing the dimensions of the concrete footing for the steel cut-off wall, revisions of the masonry retaining wall, placing the 20-inch control valve upstream of the steel cut-off and encasing the drain pipe in concrete. A review of the final revised design drawing indicates that all of the above recommendations were complied with except for redesigning the spillway weir and the relocation of the control valve.

Construction was begun in the spring of 1947. According to a document dated July 2, 1947, the foundation rock was exposed at this time and cleaned for inspection preparatory to placing the embankment.

Due to unanticipated construction costs, the dam was not completed as originally scheduled. On February 10, 1950 an inspection was made by the Commonwealth of Pennsylvania (Department of Forest and Waters). At this time, the steel sheet cut-off wall (except for an 8 foot section left out for flood flow conditions) and the access manhole and retaining wall footing were in place. Construction was resumed in the spring of 1950 and a subsequent inspection was

made by the State. Recommendations made as a result of this inspection included excavating fill material from a drier borrow area and placing the material in shallower lifts to allow for more drying time. The inspector stated that the compaction is good, even though "the resultant fill is rubbery in texture, springing under heavy loads and the sheepsfoot roller, but showing no indication of rutting." He also indicated that during the compaction process, there had been a slight displacement of the steel sheet cut-off apparently from rolling pressures, but that the displacement was not considered serious. The inspector directed the Engineer to instruct the masons to be more careful in filling the voids in the masonry wall.

A second delay was encountered due to a court injunction by the Big Inch Pipeline Company. The Owners of this Company delayed the completion of the dam until they could anchor a 20-inch diameter gas supply pipeline which is submerged by the impoundment.

The state was notified by the Owner in writing on November 6, 1953, that the dam was completed.

h. Normal Operating Procedures. No restraints exist to flow over the spillway. The remnants of a flashboard support system are in position but the flashboards are no longer used. The reservoir drain valve is apparently no longer used or exercised and appears to be inoperable.

1.3 Pertinent Data

a. Drainage Area (Square Miles)	4.1
b. Discharge at Dam Site (CFS)	
Maximum Known Flood at Dam Site	Unknown
Maximum Spillway Capacity at Low Point of Top of Dam	2,040
c. Elevations (Feet above MSL, estimated from USGS quad)	
Top of Dam (Design Top of Dam and Low Point Top of Dam)	148
Spillway Crest	140
Normal Pool	140
Reservoir Drain Pipe Outlet	123
Streambed at Downstream Toe	121±
d. Reservoir Length (Feet)	
Normal Pool	2,100
Top of Dam	2,600
e. Reservoir Storage (Acre-Feet)	
Normal Pool	49
Top of Dam	121
f. Reservoir Surface Area (Acres)	
Normal Pool	8
Top of Dam	10

g. Dam Data

Type		Earth
Length		150 Feet
Height (Above Streambed)		27 Feet
Crest Width		26 Feet
Freeboard at Normal Pool		8 Feet
Volume of Fill		9,000 Cubic Yards
Side Slopes	Upstream	3:1
	Downstream	2:1
Cut-off		Steel Sheet 0.25 inches thick
Foundation Treatment		None

h. Spillway

Type	Ungated-excavated in rock
Elevation at Crest	140
Length	30 feet
Discharge Channel	Rock

i. Outlet Works

Type	20-inch diameter CI pipe
Control	Inoperable 20-inch diameter gate valve
Location	Through base of maximum section of embankment

SECTION 2

ENGINEERING DATA

2.1 Design

a. Data Available. A summary of engineering data available for Solebury Farm Dam is included as Appendix B of this report.

A construction drawing entitled "Earth Dam with Steel Core and Natural Rock Spillway for Lowell M. Birrell, Esq." by Campbell Water Wheel Co. was made available. The drawing includes the plan, profile and sections of the dam and details of the proposed construction. No "as-built" drawings were made available.

b. Design Features. The principal design features are illustrated on the drawing reproduced in Appendix E. Information was obtained from this drawing and measurements made during the inspection. A detailed description of the design features is included in Section 1.2.a and a summary of the pertinent features is included in Section 1.3.

2.2 Construction

Documented information available relative to construction of the dam is limited to brief inspection memorandums prepared by Engineers of the Commonwealth of Pennsylvania, Department of Forest and Waters. No references to on-site inspections made by the design engineer can be found. No records of repairs made to the dam are on file.

2.3 Operational Data

According to the Owner's representative, no reservoir stage or rainfall records are maintained and no operational procedures are performed at the dam.

2.4 Evaluation

a. Availability. Information was obtained from the files of the Department of Environmental Resources (DER), Harrisburg, Pennsylvania and supplemented by discussions with the Owner's representative during and after the inspection.

b. The information made available by DER, conversations with the Owner's representative and observations made during the field investigation provided adequate data for a Phase I evaluation.

c. Validity. The available information from the above sources appears to be valid.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The observations and comments of the field inspection team are presented in Appendix A of this report. At the time of the inspection, the water surface was approximately one inch above the spillway crest. The overall appearance of the dam is fair, although the thick overgrowth on the dam made a complete visual assessment difficult.

b. Dam. The alignment of the upstream embankment face appears to be good. Although no slope protection exists, no distressed areas were noted.

The vertical alignment of the top of the dam varies approximately one foot over the 150 foot length of the dam with the design top of the dam being the low point. A survey profile of the vertical alignment is presented as Sheet 5B, Appendix A.

The downstream embankment face appears to be uniform. No areas of slope failure were noted. Seepage estimated at 2 gpm was evident about 10 feet from the toe of the dam and 20 feet from the spillway outlet channel. The seepage appeared to be clear at the time of the inspection.

The entire embankment is overgrown with trees and brush. Trunk diameters range up to 12 inches with heights approaching 30 feet.

c. Appurtenant Structures. The spillway is excavated into bedrock which appears to be resistant to weathering. No areas of scour or rock deterioration were observed.

A concrete footing and pier system is located on the spillway crest. No references to this improvement is made on the design drawings nor in any available correspondence thereafter. It appears that this structure was used to support flashboards approximately 18 to 24 inches high to increase the normal pool elevation. The flashboards were not in place at the time of inspection.

The vertical alignment of the stone masonry retaining wall along the right side of the spillway channel appears to be good; however, the wall appears to need pointing. No seepage or stone displacement was noted.

The spillway channel is poorly maintained. Trees are growing in the channel and it is littered with fallen trees and debris. The downstream channel (50 to 100 feet downstream of the dam axis) is a few feet narrower than the spillway crest width.

The intake for the reservoir drain is submerged and could not be observed. The access manhole to the valve chamber is located in the dam crest and is covered by a steel plate. The stone masonry manhole, about 25 feet deep, needs pointing. Due to the unknown condition of the ladder rungs set in the masonry wall, an inspection was

not made of the 20-inch diameter control valve located at the bottom of the manhole. It is not known if the valve is operational. A steel pipe is located in the manhole which is apparently used to operate the gate mechanism from the dam crest. The outlet of the reservoir drain pipe is partially submerged. No observations could be made on the condition of the pipe.

d. Reservoir. The banks adjacent to the reservoir are heavily wooded and slope steeply (up to 50 percent) to the reservoir. No indications of slope instability were noted. Access to the reservoir appears to be well controlled by the present Owner.

e. Downstream Channel. The banks of the channel are relatively flat and wooded on both sides. The channel slope is about 0.25 percent.

3.2 Evaluation

Based on visual observations, the dam and appurtenances appear to be in fair condition; however, the thick overgrowth prohibits a complete assessment. Continued lack of maintenance could lead to the development of detrimental conditions.

SECTION 4

OPERATION PROCEDURES

4.1 Procedures

Under normal operating procedures, water is discharged over the spillway. According to the Owner's representative, it is not known when the control valve of the reservoir drain was last used. Also, according to the Owner's representatives, the flash board system on the spillway is no longer used.

4.2 Maintenance of the Dam

According to the Owner's representative, no maintenance program exists for the dam.

4.3 Maintenance of Operating Facilities

According to the Owner's representative, no maintenance program exists for the operating facilities.

4.4 Warning Systems in Effect

According to the Owner's representative, no formal warning system or procedures are established for monitoring the structure during periods of heavy rainfall or in the event impending dam failure.

4.5 Evaluation

A formal maintenance program for the dam and appurtenances should be developed and implemented. Records of all maintenance performed should be maintained by the Owner.

Periodic inspection of the dam and appurtenances should be made by a qualified engineer. The control valve should be operated for his inspection. Maintenance records should also be reviewed by the engineer.

The dam should be monitored during periods of heavy rainfall and a system for warning downstream residents should be developed. If the integrity of the structure is threatened, local authorities should be notified.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features

a. Design Data. Design information relative to the dam is limited to correspondence between the design engineer and the Department of Forest and Waters concerning estimates of the watershed area, discharge rates per unit of watershed area and the weir coefficients for the proposed spillway.

The watershed has a maximum width of about 1.4 miles and a maximum length of about 3.0 miles. Elevations range from approximately 465 to the normal pool El. 140. The 4.1 square mile drainage area is essentially rural with open pasture, farmland, some wooded areas and a limited amount of residential development.

b. Experience Data. According to the Owner's representative, no rainfall or spillway discharge records are maintained. No evidence that the embankment had ever been overtopped was apparent during the inspection.

c. Visual Observations. The spillway is littered with debris and trees are growing in the spillway channel. The remnants of a flashboard support system are located at the spillway crest. It is doubtful that the spillway could perform as designed.

d. Overtopping Potential. Solebury Farm Dam is classified as a "Small" size, "High" hazard dam. Accordingly, the Spillway Design Flood (SDF) ranges from fifty percent of the PMF to the PMF. Because of the limited number of inhabitable dwellings located downstream, fifty percent of the PMF was selected as the appropriate SDF. The SDF hydrograph was routed through the reservoir with the starting water surface at the spillway crest, El. 140. The peak inflow and outflow rates for the SDF are about 6,270 cfs and 6,210, respectively. The maximum reservoir stage for this event is about 3.4 feet above the top of the dam; the duration of overtopping is 5.5 hours. The dam is capable of discharging about 18 percent of the PMF before overtopping occurs.

e. Spillway Adequacy. In order to assess the potential for increased damage due to dam failure, the embankment was assumed to breach with water flowing one foot deep over the low point of the top of the dam for a period of one hour. A review of the results of this analysis indicates that the water surface elevation at the damage center is one foot higher for the breach condition than for the non-breach condition. The spillway is classified as "Inadequate" since it is not capable of passing the SDF; however, it is not classified as "Seriously Inadequate" since the breaching of the dam does not significantly increase the downstream hazard because the non-breach condition already floods the damage center.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observation. The overall structural appearance of the dam at the time of inspection was fair. The heavy growth of trees on the embankment could result in serious damage to the structure if the trees were uprooted resulting in the loss of embankment material. Tree roots could also seriously affect the integrity of the masonry wall. The thick cover of trees on the dam makes visual observations of the embankment difficult.

The steel sheet cut-off could not be observed during the inspection. A localized area of seepage was noted about 10 feet downstream of the toe of the embankment near the spillway outlet channel. The water appeared to be clear with a flow rate estimated to be 2 gpm. The seepage may be occuring along the embankment/masonry wall interface. The effects of the seepage on the embankment could not be assessed during the inspection.

The stone masonry retaining wall and access manhole appear to be in fair condition with both structures in need of pointing to limit further deterioration. Failure of either stone masonry structure could result in serious damage to the embankment.

The exposed rock in the spillway appears to be stable and resistant to erosion. No indication of foundation deterioration was noted.

Based on the observations made during the visual insepction, the dam appears to be structurally stable.

b. Design and Construction Data. Limited design and construction data is available. It appears that the dam was constructed in reasonable accordance with the design plans.

Delays during construction may have been advantageous for fill consolidation. Concern was expressed by Department of Forest and Waters representatives about the effectiveness of fill compaction adjacent to the steel cut-off. Based on the crest survey, it appears that insignificant settlement has occurred.

A review of the available design drawing reveals no information as to the permeability or strength characteristics of the embankment and foundation material. No calculations were made available relative to structural or slope stability.

c. Operating Records. According to the Owner's representative, no operating records are available.

d. Post-Construction Changes. There is no record of any post-construction changes. However, it appears that the spillway was modified with a flashboard system which was subsequently abandoned.

e. Seismic Stability. Solebury Farm Dam is located in Seismic Zone 1 as shown on the Seismic Zone Map of Contiguous States. A dam located in Seismic Zone 1 is considered to be structurally adequate for Zone 1 earthquake loading if it is structurally adequate for static loading.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Evaluation. Based on visual observations, the dam and appurtenances appear to be in fair condition; however, the thick overgrowth prohibits a complete assessment. Continued lack of maintenance could lead to the development of detrimental conditions.

The source of seepage noted about 10 feet downstream of the toe of the dam near the spillway outlet channel could not be determined during the inspection. The seepage may be occuring along the embankment/masonry wall interface.

The spillway channel appears to be in good condition. However, the channel has trees growing in it and is littered with debris which reduces the discharge capacity.

The masonry wall and manhole appear to need pointing and the condition of the ladder rungs set in the masonry wall of the manhole is unknown. According to the Owner's reprsentative, it is not known if the control valve on the reservoir drain is operable.

The SDF for Solebury Farm Dam is fifty percent of the PMF. Based on a review of the hydrologic/hydraulic analyses, the spillway will pass approximately 18 percent of the PMF prior to embankment overtopping. The spillway capcity is classified as "Inadequate". However, it is not classified as "Seriously Inadequate" since breaching of the dam does not significantly increase the downstream hazard potential.

b. Adequacy. The information made available by DER, conversations with the Owner's representative and observations made during the field investigation provided adequate data for a Phase I evaluation.

c. Urgency. The remedial measures recommended in Section 7.2 should be effected immediately.

d. Necessity for Further Investigation. Further investigation should be implemented as discussed in Section 7.2.a.

7.2 Recommendations and Remedial Measures

The following recommendations and remedial measures should be initiated immediately. The Owner should retain the services of a licensed professional engineer experienced in the design and construction of dams to assist in complying with these recommendations and remedial measures.

a. Facilties.

1. A detailed hydrologic/hydraulic study should be performed to determine the best method of increasing spillway capacity to make it hydraulically adequate.

2. The embankment should be cleared of all trees and brush and any resulting voids should be backfilled with suitable compacted material. A grass cover should be established and maintained on the slopes and crest of the dam.

3. An investigation should be made to assess the source and nature of seepage observed near the spillway outlet channel.

4. The control valve should be restored to an operable condition. Measures should be taken to insure that the control valve is accessible for all flow conditions. Provisions should be made for emergency closure of the outlet pipe upstream of the steel cut-off.

5. Riprap should be placed on the upstream face of the dam to protect the embankment from wave action.

6. The masonry retaining wall and access manhole should be repointed to limit deterioration. The ladder rungs in the manhole should be inspected and repaired if necessary.

7. The spillway should be cleaned of all debris. The flashboard system and trees growing in the spillway should be removed.

b. Operation and Maintenance.

1. A formal maintenance and inspection program should be developed and implemented to insure that the dam and appurtenances are maintained on a regularly schedules basis. Maintenance performed should be recorded to provide a history of corrected deficiencies.

2. A downstream warning system should be developed. During periods of heavy rainfall, the dam should be monitored and appropriate agencies should be alerted in the event of an impending failure.

APPENDIX A

CHECKLIST
VISUAL INSPECTION

CHECK LIST
VISUAL INSPECTION
PHASE I

Name Dam Solebury Farm Dam County Bucks State Pennsylvania National NDI ID PA 00944

Type of Dam Rolled Earth Hazard Category High

Date(s) Inspection 12/15/80 Weather Clear Temperature 35°

Pool Elevation at Time of Inspection ±140 M.S.L. Tailwater at Time of Inspection ±121 M.S.L.

Inspection Personnel:

L.H. DeHeer J. Rauschkolb

L. Beck

R.E. Horvath

L.H. DeHeer Recorder

Remarks:

The inspection team was accompanied by Mr. Lawrence Katz, Mr. R. Stanley Cornell, Ms. Barbara Kemper and Mr. Robert Miller (representing Solebury Farm Joint Venture).

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	N/A	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N/A	
DRAINS	N/A	
WATER PASSAGES	N/A	
FOUNDATION	N/A	

Sheet 2 of 11

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A	

Sheet 3 of 11

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The horizontal alignment of the crest appears to be good. The results of the field survey revealed that the maximum variation in vertical alignment is about one foot. The minimum crest elevation is equal to the design elevation.	
RIPRAP FAILURES	Riprap has not been used.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No detrimental conditions were noted at the time of inspection.	
ANY NOTICEABLE SEEPAGE	Seepage was noted at the toe of the embankment near the spillway. The flow rate was estimated at 2 gallons per minute; the water appeared to be clean.	Ponded water should be drained away from the toe of the dam. The seepage should be observed on a scheduled basis to detect any variations in flow quantity or quality.
STAFF GAGE AND RECORDER	None observed.	
DRAINS	None observed.	

Sheet 5 of 11

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The reservoir drain conduit is constructed through embankment and is not exposed for visual inspection.	
INTAKE STRUCTURE	Not observed, submerged under normal conditions.	
OUTLET STRUCTURE	The outlet for the reservoir drain is partically submerged. No deterioration was detected on the portion of the structure visible.	
OUTLET CHANNEL	The outlet channel blends into the natural downstream channel.	
EMERGENCY VALVE CONTROL	The valve is at the base of the manhole located at maximum section of the dam. It is inaccessable and believed to be inoperable.	The valve should be restored to operable condition & made accessable.

Sheet 6 of 11

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The spillway was excavated into bedrock. Erosion or deterioration of the rock appears to be minimal. The weir (rock not concrete) is difficult to decipher.	
APPROACH CHANNEL	The approach channel was excavated into bedrock. Erosion or deterioration of the rock appears to be minimal. The approach channel is littered with debris.	Remove debris from the approach channel.
DISCHARGE CHANNEL	The discharge channel was excavated into bedrock. Erosion or deterioration of the rock appears to be minimal.	
BRIDGE AND PIERS	The support system for flashboards (footer and piers) is located at the spillway crest.	The flashboards are no longer used. The support system should be removed.

Sheet 7 of 11

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

Sheet 8 of 11

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	None	

Sheet 9 of 11

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The slopes adjacent to the reservoir are relatively steep and heavily wooded. No indications of slope instability were noted.	
SEDIMENTATION	The drainage area consists predominately of farm lands. However, the farms appear to be inactive at the present time and a good vegetative cover has been established. It is reasonable to assume that the current rate of sedimentation is low.	

Sheet 10 of 11

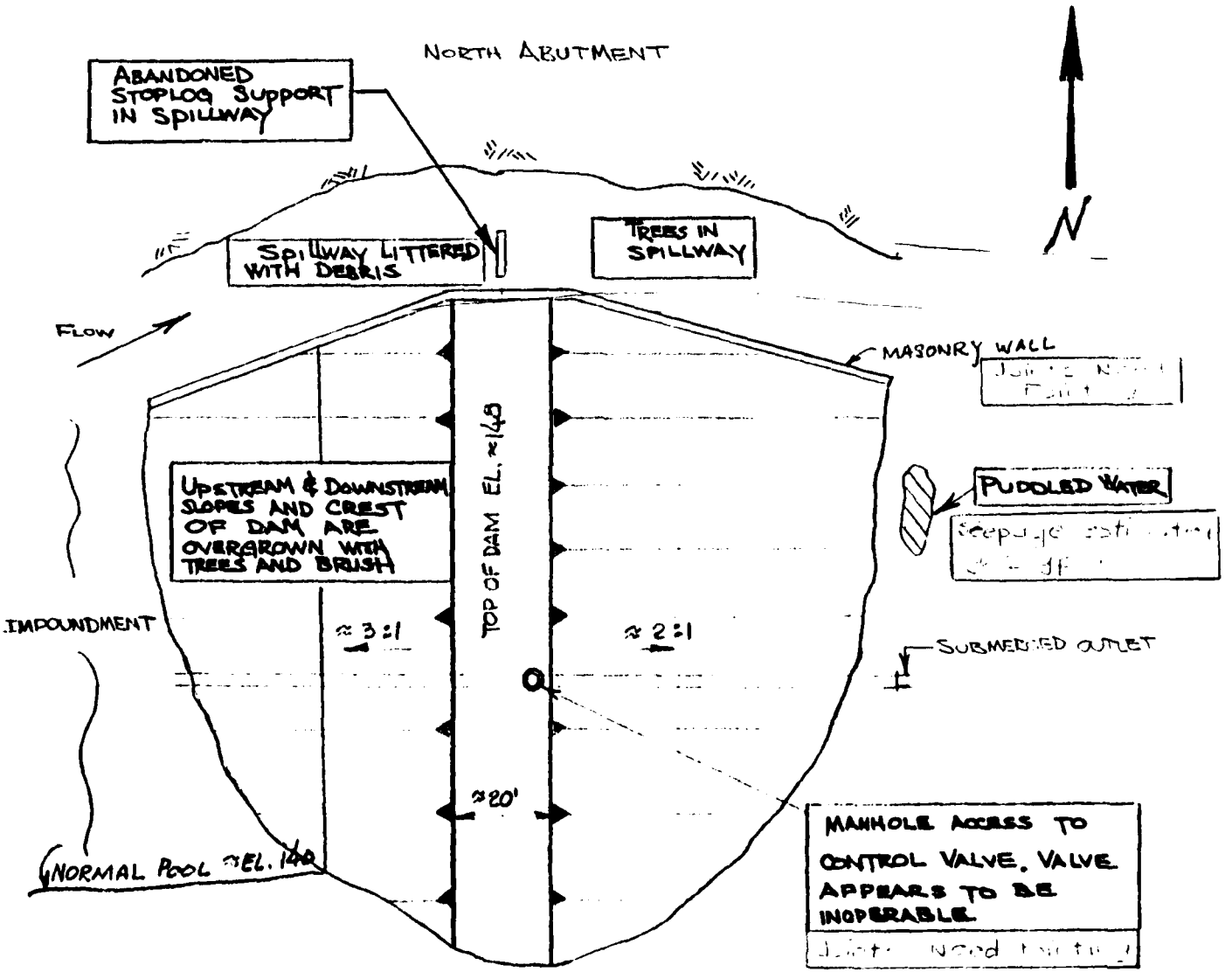
DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	No obstructions were noted during the field inspection.	
SLOPES	The overbanks of the downstream channel are relatively flat.	
APPROXIMATE NO. OF HOMES AND POPULATION	The nearest buildings that may be effected by a dam failure are located about one mile downstream of the dam. The structures include a restaurant and a house. The lowest door sill of the house is about 3 feet above the stream bed.	

Sheet 11 of 11

O'BRIEN & GERE ENGINEERS, INC.

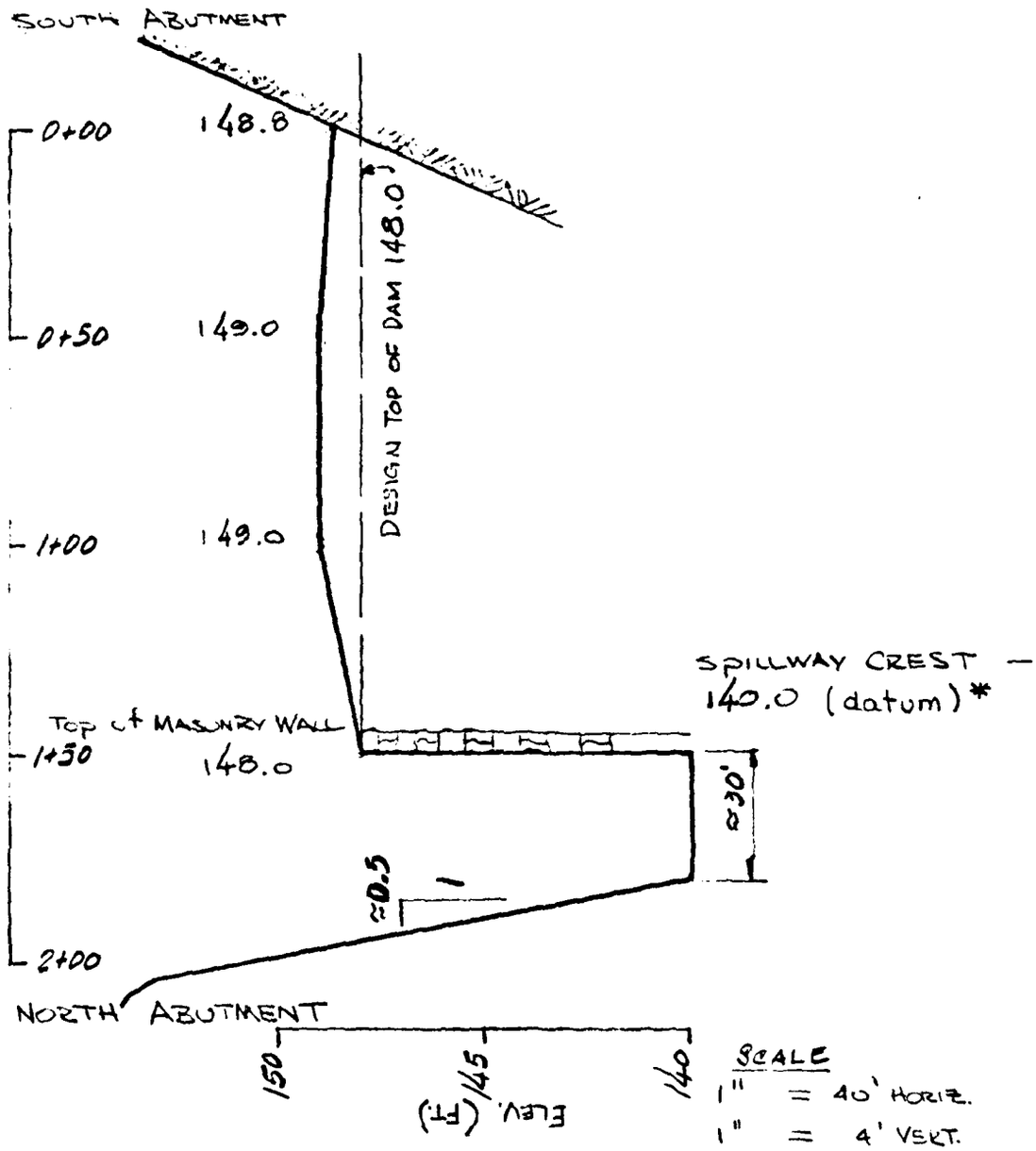
SUBJECT	SHEET	BY	DATE	JOB NO
SCHENEVUS FALLS DAM	11A	REH	12/17/80	1941-014



- NO SCALE

O'BRIEN & GERE
ENGINEERS, INC

SUBJECT	SHEET	BY	DATE	JOB NO
SOLEBURY FARM DAM	11B	REH	12/17/80	1841-014



* DATUM ELEVATION ESTIMATED FROM USGS QUAD SHEET

APPENDIX B

CHECKLIST
ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Solebury Farm Dam

NDI ID PA 00944

ITEM	REMARKS
AS-BUILT DRAWINGS	No "as built" drawings are available.
REGIONAL VICINITY MAP	Refer to Appendix E, Figure 1
CONSTRUCTION HISTORY	Construction history is limited to a correspondence file initiated by the State in 1947.
TYPICAL SECTIONS OF DAM	Typical sections are shown on a proposed plan drawing prepared in 1947 by the Campbell Water Wheel Co. Refer to Appendix E.
OUTLETS - PLAN	Refer to Appendix E
DETAILS	
CONSTRAINTS	
DISCHARGE RATINGS	None available.
RAINFALL/RESERVOIR RECORDS	Rainfall/reservoir records are not maintained by the owner.

Sheet 1 of 4

ITEM	REMARKS
DESIGN REPORTS	None available
GEOLOGY REPORTS	None available
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available.
POST-CONSTRUCTION SURVEYS OF DAM	None available.
BORROW SOURCES	Apparently on site borrow sources.

Sheet 2 of 4

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	None documented. Aparently a spillway flashboard system was installed after the dam was completed.
HIGH POOL RECORDS	Records are not maintained.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None availalbe
MAINTENANCE OPERATION RECORDS	None available.

Sheet 3 of 4

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	Refer to Appendix E
OPERATING EQUIPMENT PLANS & DETAILS	Refer to Appendix E
MISCELLANEOUS	

Sheet 4 of 4

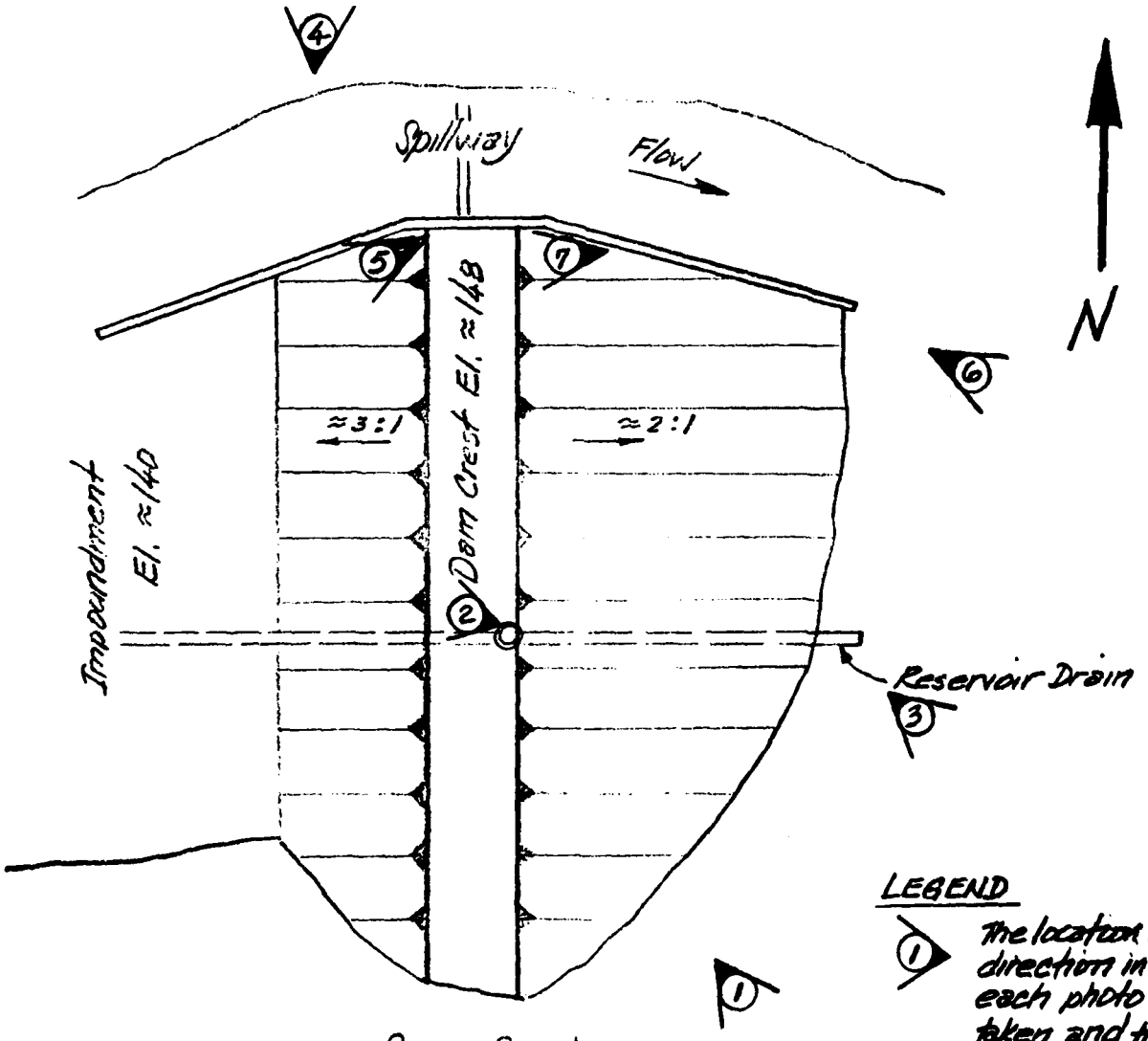
APPENDIX C

PHOTOGRAPHS

APPENDIX C
SELECTED PHOTOGRAPHS OF THE PROJECT

O'BRIEN & GERE
ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
Solebury Farm Dam	A	[illegible]	1/15/81	1841-014



SITE PLAN

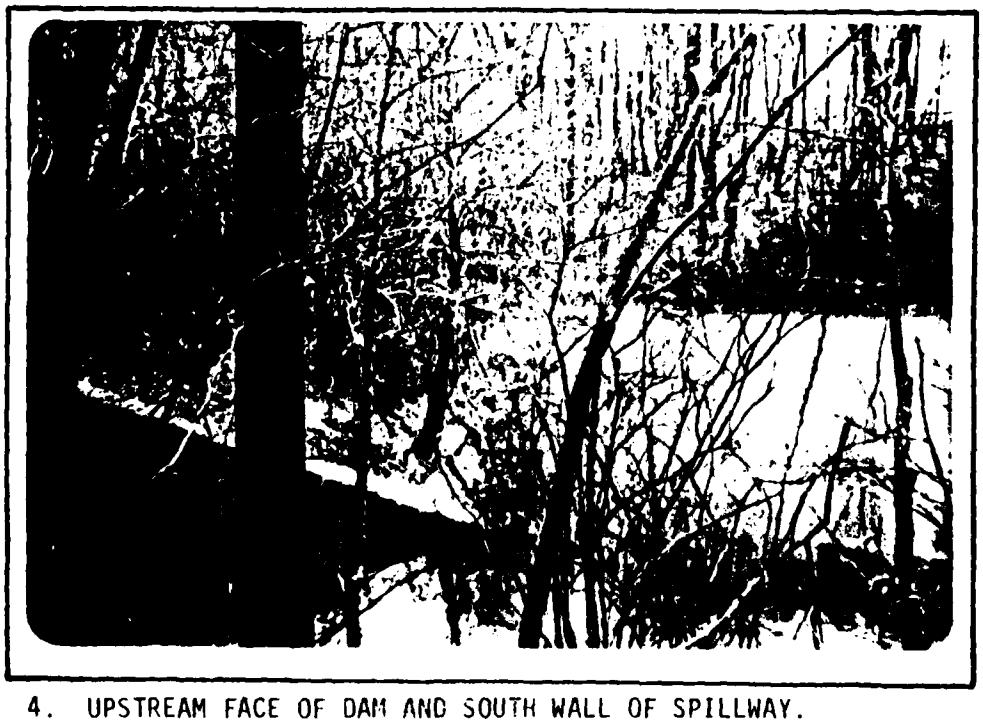
LEGEND

(1) The location and direction in which each photo was taken and the number of the photo

1. DOWNSTREAM FACE OF THE DAM VIEWED FROM THE SOUTH ABUTMENT. (12/15/80)

2. MANHOLE ACCESS TO RESERVOIR DRAIN VALVE CONTROL. (12/15/80)

3. OUTLET OF RESERVOIR DRAIN. (12/15/80)



4. UPSTREAM FACE OF DAM AND SOUTH WALL OF SPILLWAY. (12/15/80)

5. SPILLWAY SHOWING STOPLOG SUPPORT IN FOREGROUND. (12/15/80)

6. SPILLWAY DISCHARGE CHANNEL. (12/15/80)

7. DOWNSTREAM CHANNEL VIEWED FROM SPILLWAY WALL. (12/15/80)

8. POTENTIAL DAMAGE AREA APPROXIMATELY ONE MILE DOWN_ STREAM FROM THE DAM. (12/15/80)

APPENDIX D

HYDROLOGIC AND HYDRAULIC ENGINEERING DATA

SOLEBURY LAKE DAM
APPENDIX D
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

TABLE OF CONTENTS

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Rural, open farmland & wooded areas

*ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 140 (49 A.F.)

*ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 148 (121 A.F.) Top of Dam

*ELEVATION MAXIMUM DESIGN POOL: _____

*ELEVATION TOP DAM: 148

SPILLWAY

a. *Elevation 140

b. Type Rock cut

c. Width ≈30 feet

d. Length ≈170 feet

e. Location Spillover Left Abutment

f. Number and Type of Gates None

OUTLET WORKS:

a. Type 20-inch diameter concrete pipe

b. Location At low point of valley

c. Entrance invert ≈*El. 122

d. Exit invert ≈*El 121

e. Emergency draindown facilities 20 inch diameter control valve near mid point of dam (inoperable)

HYDROMETEOROLOGICAL GAGES:

a. Type None within watershed

b. Location N/A

c. Records N/A

MAXIMUM NON-DAMAGING DISCHARGE: Not Known

* Elevations estimated from USGS quad.

HEC-1, REVISED
FLOOD HYDROGRAPH PACKAGE

The original "Flood Hydrograph Package" (HEC-1), developed by the Hydrologic Engineering Center, Corps of Engineers, has been modified for use under the National Dam Inspection Program. The "Flood Hydrograph Package (HEC-1), Dam Safety Version", hereinafter referred to as, HEC-1, Rev., has been modified to require less detailed input and to include a dam breach analysis. The required input is obtained from the field inspection of a dam, any available design/evaluation data, relatively simple hydraulic calculations, or information from the USGS Quandrangle maps. The input format is flexible in order to reflect any unique characteristics of an individual dam.

HEC-1, Rev. computes a reservoir inflow hydrograph based on individual watershed characteristics such as: area, percentage of impervious surface area, watershed shape, and hydrograph characteristics determined from regional correlation studies by the Corps of Engineers, Baltimore District. The inflow is routed through the reservoir using spillway discharge data obtained from the field inspection or design data. Flood storage capacity is determined from USGS maps or design information and verified by the field inspection. In the event a spillway cannot discharge 0.5 PMF without overtopping and failure of the dam, downstream channel characteristics obtained from the field inspection and USGS maps are inputed and flows are routed downstream to the damage center and a dam breach analysis is performed 1/

Included in this Appendix are the HEC-1, Rev. pertinent input values and a summary print-out.

1/ "High" hazard structures only

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
[illegible] Farm Dam	3	[illegible]	[illegible]	1841-014

1/20/81

HYDROLOGY

- DRAINAGE AREA (PLANIMETERED FROM USGS QUAD SHEET) = 4.1 SQ. MI.

- DESIGN FLOOD

Size Classification - Small
Hazard Classification - High

USE ½ PMF

- PMP Determination (HR # 33)

Salisbury Farm Dam is located in Zone Number 6

PMP = 23" (200 sq miles - 24 hours)

Time (Hrs)	Percent	Rainfall (Inches)
6	112	25.8
12	124	28.5
24	132	30.4
48	142	32.7

- SNYDER COEFFICIENTS (Provided By Balt. Dist. COE)

SECTION 4B

C_t = 0.60
C_p = 0.43

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
SOLEBURY FARM DAM	4	ZEH	12-17-80 2-11-81	1841-014

HYDROLOGY (CONT)

$t_p = 0.6 (L \times L_{CA})^{.3}$

$L = 3.2$ miles

$L_{CA} = 1.3$ miles

$t_p = 0.6(3.2 \times 1.3)^{.3} = .92$ hours

HYDRAULICS

— Spillway Discharge $Q = C L H^{3/2}$

$C = 3.0$
- Trapezoidal cross-section
- Rock lining in channel - rough
- spillway channel is non-uniform

$L = 30$ feet

H = Hydraulic head on spillway, assume velocity head is negligible

— Embankment Overtopping Discharge $Q = CLH^{3/2}$

$C = 3.0$ (assumed average)

$L = 1500.0$ feet, average length of embankment subject to overtopping

H = Hydraulic head on embankment, assume velocity head is negligible

— Stage/Storage Calculations

Pool Status	Stage	Area (Acres)
- No pool	121	0 (assumed)
- Normal pool	140	7.7 (planimetered from quad sheet)
- Contour (above normal pool)	160	15.0 (planimetered from quad sheet)

```
**********
FLO   HYDROGRAPH PACKAGE (HEC-1)
DAM   FIFTY YEAR MODIFIED      JULY 197-
  LAST MODIFICATION  21 APR 78
**********
    1                A1                        NATIONAL DAM INSPECTION PROGRAM
    2                A2                              COLEPURY FARM DAM
    3                A3                                 ENE HYDROGRAPH
    4                B     300        0       15        0        0        0        0        0       -4        0
    5                B1      5
    6                C       1        7        1
    7                J1   .05      .15      .20      .25      .30      .50     1.0
    8                K       0   INFLOW                                          1
    9                K1                          RUNOFF TO COLEPURY FARM DAM
   10                M       1        1      4.1                                                    1
   11                E       0       23      112      124      132      142
   12                T                                                        1.0      .05
   13                T1   .52      .43
   14                X   -1.5     -.05        2
   15                K       1   OUTFLOW
   16                K1                          ROUTING THROUGH COLEPURY FARM DAM
   17                X                                 1        1
   18                X1      1                                                      -140
   19                RA      0      7.7       15
   20                RT    121      140      160
   21                RS    140       30        2      1.7
   22                RC    148        2      1.5      150
   23                ZZ
```

REVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT INFLOW
ROUTE HYDROGRAPH TO OUTFLOW
END OF NETWORK

Sheet 5

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 01 APR 80
****

RUN DATE= 81/01/19.
TIME= 12.29.29.

NATIONAL DAM INSPECTION PROGRAM
SOLEBURY FARM DAM
PMF HYDROGRAPH

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 7 LRTIO= 1
RTIOS= .05 .15 .20 .25 .30 .50 1.00

SUB-AREA RUNOFF COMPUTATION

RUNOFF TO SOLEBURY FARM DAM

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
INFLOW	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	4.10	0.00	4.10	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	27.00	112.00	124.00	132.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .900

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOW	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= .92 CP= .43 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 71 END-OF-PERIOD ORDINATES, LAG= .92 HOURS, CP= .43 VOL= 1.00

12.	540.	1009.	1195.	1111.	980.	812.	678.	564.	469.
474.	371.	314.	272.	232.	199.	170.	145.	124.	106.
91.	78.	66.	57.	49.	42.	36.	30.	26.	22.

Sheet 6

18. 16. 14. 12. 10. 8.

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	26.13	23.74	2.39	25462.
										(664.)	(603.)	(61.)	(7210.29)

****

HYDROGRAPH ROUTING

ROUTING THROUGH SCLEBURY FARM DAM

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
OUTFLOW	1	0	0	0	0	0	0	0

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-140.	0

SURFACE AREA=	0.	8.	15.
CAPACITY=	0.	49.	272.
ELEVATION=	121.	140.	160.

CREL	CSPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
140.0	30.0	3.0	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
148.0	3.0	1.5	150.

PEAK OUTFLOW IS 574. AT TIME 41.00 HOURS

PEAK OUTFLOW IS 1747. AT TIME 41.00 HOURS

PEAK OUTFLOW IS 2451. AT TIME 40.75 HOURS

PEAK OUTFLOW IS 3104. AT TIME 40.75 HOURS

PEAK OUTFLOW IS 4727. AT TIME 40.75 HOURS

PEAK OUTFLOW IS 6210. AT TIME 40.75 HOURS

PEAK OUTFLOW IS 10409. AT TIME 40.75 HOURS

Sheet 7

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .05	RATIO 2 .15	RATIO 3 .20	RATIO 4 .25	RATIO 5 .30	RATIO 6 .50	RATIO 7 1.00
HYDROGRAPH AT	INFLOW	4.10	1	627.	1882.	2508.	3136.	3763.	6272.	12544.
		(10.62)		(17.76)(	53.28)(	71.04)(	88.80)(	106.56)(	177.60)(	355.20)(
ROUTED TO	OUTFLOW	4.10	1	574.	1767.	2451.	3104.	3727.	6210.	12409.
		(10.62)		(16.27)(	50.05)(	69.42)(	87.91)(	105.53)(	175.86)(	351.40)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	140.00	140.00	146.00
STORAGE	49.	49.	121.
OUTFLOW	0.	0.	2036.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.05	143.44	0.00	77.	574.	0.00	41.00	0.00
.15	147.29	0.00	113.	1767.	0.00	41.00	0.00
.20	144.57	.57	127.	2451.	1.50	40.75	0.00
.25	149.20	1.20	135.	3104.	2.50	40.75	0.00
.30	149.71	1.71	139.	3727.	3.25	40.75	0.00
.50	151.36	3.36	157.	6210.	5.50	40.75	0.00
1.00	154.49	6.49	195.	12409.	7.75	40.75	0.00

Sheet 8

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
**********
```

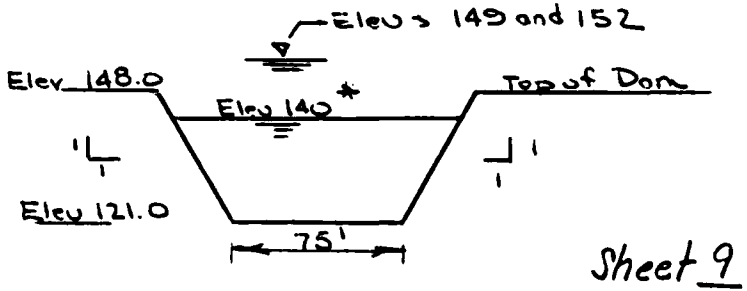
```
    1                A1                        NATIONAL DAM INSPECTION PROGRAM
    2                A2                              SOLEBURY FARM DAM
    3                A3                               PMF HYDROGRAPH
    4                B     300        0       15        0        0        0        0        0       -4        0
    5                B1      5
    6                J       2        1        1
    7                J1    .25
    8                K       0   INFLOW                                                    1
    9                K1                                RUNOFF TO SOLEBURY FARM DAM
   10                M       1        1      4.1                                                       1
   11                P       0       23      112      124      132      142
   12                T                                                          1.0      .05
   13                W     .92      .43
   14                X    -1.5     -.05        2
   15                K       1   OUTFLOW
   16                K1                              ROUTING THROUGH SOLEBURY FARM DAM
   17                Y                                        1        1
   18                Y1      1                                                        -140
   19                SA      0      7.7       15
   20                SE    121      140      160
   21                SS    140       30        3      1.5
   22                SD    148        3      1.5      150
   23                SB     75        1      121        2      140      149
   24                SB     75        1      121        2      140      152
   25                K       1   BREACH
   26                K1                            ROUTING DOWNSTREAM TO DAMAGE CENTER
   27                Y                                        1        1
   28                Y1      1                                                          -1
   29                Y6    .07      .04      .07      108      128     5000    .0026
   30                Y7      0      130      200      120      380      111      390      108      400      108
   31                Y7    410      111      550      120      650      130
   32                K      99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	INFLOW
ROUTE HYDROGRAPH TO	OUTFLOW
ROUTE HYDROGRAPH TO	BREACH
END OF NETWORK	

Dam Breach Statement

The portion of the dam assumed to be breached is based on the geometry of the site. The depth of flow over the top of the dam at which failure is initiated and the elapsed time to complete failure are based on the general appearance and age of the structure. Consideration was given to the parameters used in the C.O.E. publication "Basic Concepts of Dam Breaks and Development of Dam Break Hydrographs."



Sheet 9

* Starting Water Surf. Elev

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  01 APR 80
**********************************

RUN  DATE= 81/01/21.
     TIME= 08.52.07.
```

NATIONAL DAM INSPECTION PROGRAM
SOLEBURY FARM DAM
PMF HYDROGRAPH

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 2 NRTIO= 1 LRTIO= 1

RTIOS= .25

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

RUNOFF TO SOLEBURY FARM DAM

	ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
INFLOW		0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	4.10	0.00	4.10	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.00	112.00	124.00	132.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	CLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	3.00	0.00

UNIT HYDROGRAPH DATA
TP= .92 CP= .43 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 36 END-OF-PERIOD ORDINATES, LAG= .92 HOURS, CP= .43 VOL= 1.00

152.	560.	1004.	1195.	1111.	950.	812.	695.	594.	508.
434.	371.	318.	272.	232.	199.	170.	145.	124.	106.
91.	78.	66.	57.	49.	42.	36.	30.	26.	22.

Sheet 10

19. 16. 14. 12. 10. 9.

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	26.13	23.74	2.39	254629.
										(664.)	(603.)	(61.)	(7210.29)

HYDROGRAPH ROUTING

ROUTING THROUGH SCLEBURY FARM DAM

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
LTFLOW	1	0	0	0	3	0	0	0

ALL PLANS HAVE SAME ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-140.	0

SURFACE AREA=	0.	8.	15.
CAPACITY=	0.	45.	272.
ELEVATION=	121.	140.	160.

CREL	SPWID	COGW	EXPW	ELEVL	COGL	CAREA	EXPL
140.0	30.0	3.0	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
148.0	3.0	1.5	150.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	ESEL	FAILEL
75.	1.00	121.00	2.00	140.00	149.00

BEGIN DAM FAILURE AT 40.50 HOURS

PEAK OUTFLOW IS 4036. AT TIME 41.42 HOURS

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	ESEL	FAILEL
75.	1.70	121.00	2.00	140.00	152.00

PEAK OUTFLOW IS 3104. AT TIME 40.75 HOURS

Sheet 11

HYDROGRAPH ROUTING

ROUTING DOWNSTREAM TO DAMAGE CENTER

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
BREACH	1	0	0	0	0	0	0	0

ALL PLANS HAVE SAME ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

GN(1)	GN(2)	GN(3)	ELNVT	ELMAX	RLNTH	SEL
.0700	.0400	.0700	108.0	128.0	5000.	.00260

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 130.00 200.00 120.00 380.00 111.00 390.00 108.00 400.00 108.00
410.00 111.00 550.00 120.00 650.00 130.00

STORAGE	0.00	1.63	4.11	7.48	14.05	25.13	40.74	60.87	85.52	114.70
	148.40	186.61	229.23	275.71	326.02	380.13	438.07	499.81	565.38	634.76
OUTFLOW	0.00	23.68	87.30	201.50	410.74	733.69	1201.82	1842.16	2679.27	3736.09
	5034.28	6594.51	8466.15	10649.85	13137.89	15943.63	19080.37	22561.26	26399.35	30607.48
STAGE	108.00	109.05	110.11	111.16	112.21	113.26	114.32	115.37	116.42	117.47
	118.53	119.58	120.63	121.68	122.74	123.79	124.84	125.89	126.95	128.00
FLOW	0.00	23.68	87.30	201.50	410.74	733.69	1201.82	1842.16	2679.27	3736.09
	5034.28	6594.51	8466.15	10649.85	13137.89	15943.63	19080.37	22561.26	26399.35	30607.48

MAXIMUM STAGE IS 117.6

MAXIPLP STAGE IS 116.6

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .25
HYDROGRAPH AT	INFLOW	4.10	1	3136.
		(10.62)		(88.80)
			2	3136.
				(88.80)
ROUTED TO	LTFLOW	4.10	1	4020.
		(10.62)		(113.82)
			2	3104.
				(87.91)
ROUTED TO	BREACH	4.10	1	3096.
		(10.62)		(110.26)
			2	2894.
				(81.94)

RATIOS APPLIED TO FLOWS

Sheet 12

HYDROGRAPH ROUTING

ROUTING DOWNSTREAM TO DAMAGE CENTER

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
BREACH	1	0	0	0	0	0	0	0

ALL PLANS HAVE SAME ROUTING DATA

GLOSS	CLOSS	AVC	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

GN(1)	GN(2)	GN(3)	ELNVT	ELMAX	RLNTH	SEL
.0700	.0400	.0700	108.0	128.0	5000.	.00260

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 130.00 200.00 120.00 380.00 111.00 390.00 108.00 400.00 108.00
410.00 111.00 550.00 120.00 650.00 130.00

STORAGE	0.00	1.63	4.11	7.48	14.05	25.13	40.74	60.87	85.52	114.70
	148.40	186.61	229.23	275.71	326.02	380.13	438.07	499.81	565.38	634.76
OUTFLOW	0.00	23.68	87.30	201.50	410.74	733.69	1201.82	1842.16	2679.27	3736.09
	5034.28	6594.51	8466.15	10649.85	13137.89	15943.63	19080.37	22561.26	26399.35	30607.48
STAGE	108.00	109.05	110.11	111.16	112.21	113.26	114.32	115.37	116.42	117.47
	118.53	119.58	120.63	121.68	122.74	123.79	124.84	125.89	126.95	128.00
FLOW	0.00	23.68	87.30	201.50	410.74	733.69	1201.82	1842.16	2679.27	3736.09
	5034.28	6594.51	8466.15	10649.85	13137.89	15943.63	19080.37	22561.26	26399.35	30607.48

MAXIMUM STAGE IS 117.6

MAXIPLP STAGE IS 116.6

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .25
HYDROGRAPH AT	INFLOW	4.10	1	3136.
		(10.62)		(88.80)(
			2	3136.
				(88.80)(
ROUTED TO	LTFLOW	4.10	1	4020.
		(10.62)		(113.82)(
			2	3104.
				(87.91)(
ROUTED TO	BREACH	4.10	1	3894.
		(10.62)		(110.24)(
			2	2894.
				(81.94)(

Sheet 12

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALLE	SPILLWAY CREST	TOP OF DAM
ELEVATION	140.00	140.00	148.00
STORAGE	49.	49.	121.
OUTFLOW	0.	0.	2036.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.25	149.16	1.16	133.	4036.	1.00	41.42	40.50

PLAN 2 .....

	INITIAL VALLE	SPILLWAY CREST	TOP OF DAM
ELEVATION	140.00	140.00	148.00
STORAGE	49.	49.	121.
OUTFLOW	0.	0.	2036.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.25	149.20	1.20	133.	3104.	2.50	40.75	0.00

PLAN 1 STATION BREACH

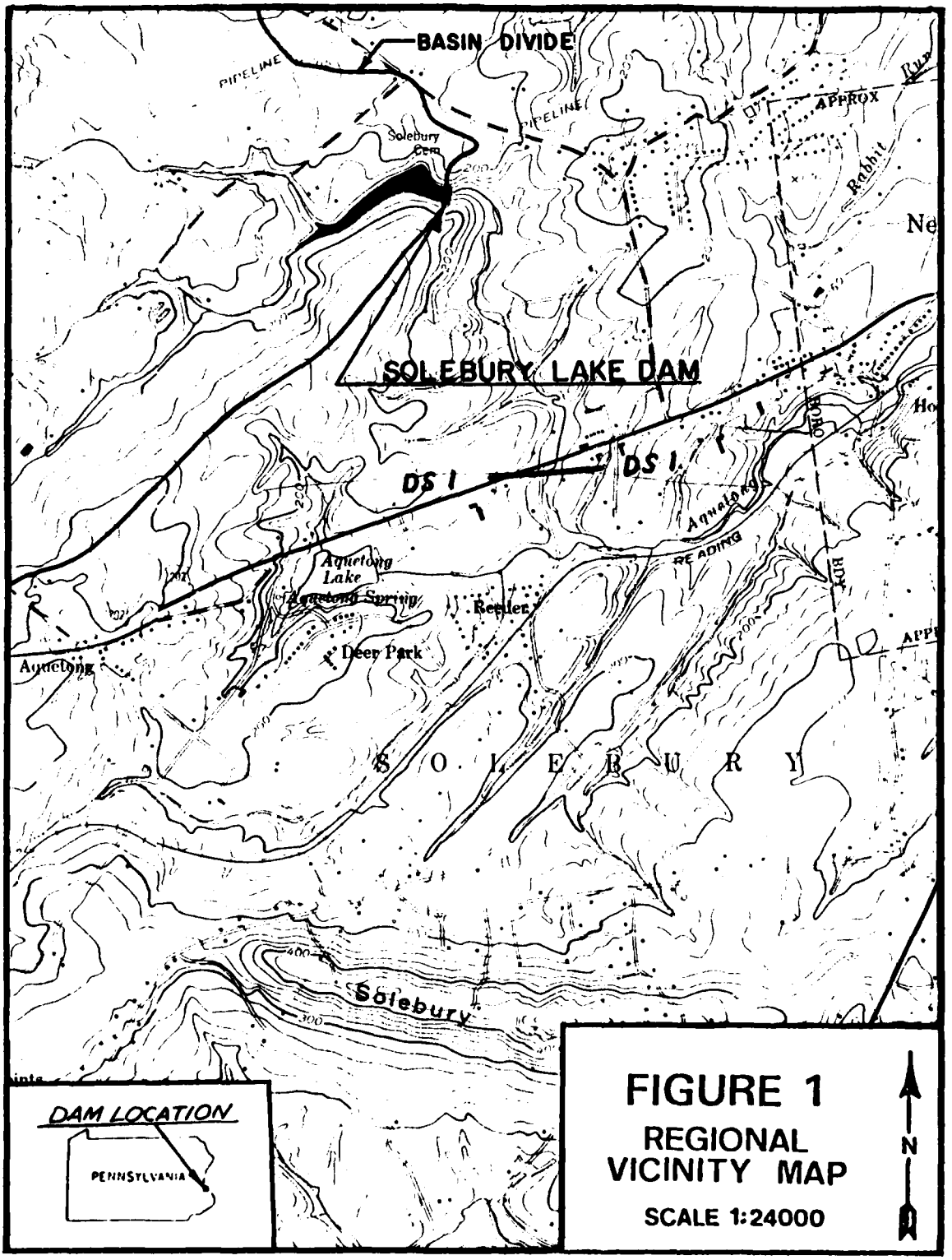
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.25	3894.	117.6	41.75

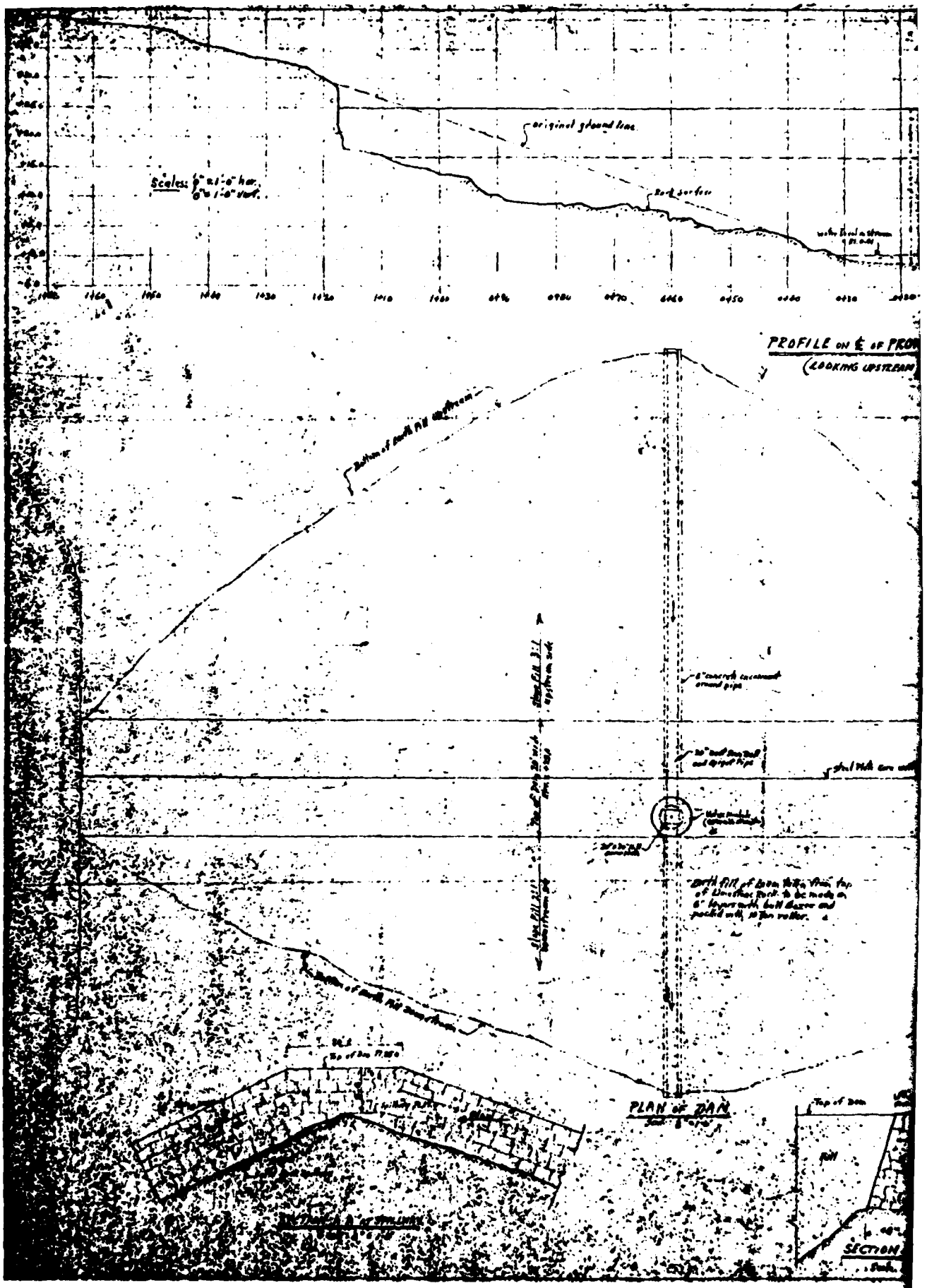
PLAN 2 STATION BREACH

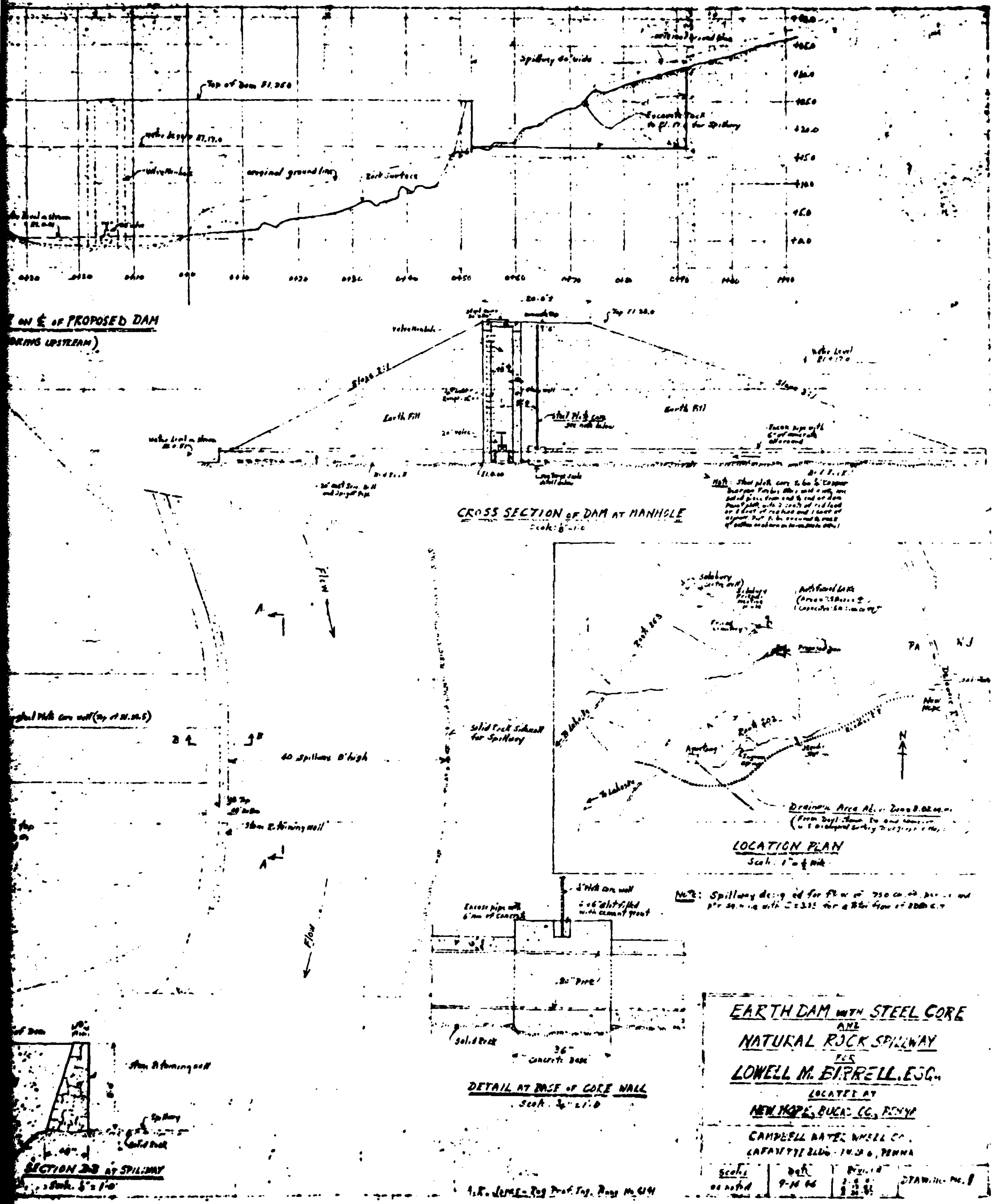
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.25	2894.	116.6	41.25

APPENDIX E

REGIONAL VICINITY MAP
&
DRAWINGS


BASIN DIVIDE
PIPELINE
PIPELINE
APPROX
Solebury Cem
Rabbit
SOLEBURY LAKE DAM
DSI
DSI
Aquetong
READING
Aquetong Lake
Aquetong Spring
Beetler
Deep Park
Aquetong
S O L E B U R Y
Solebury
DAM LOCATION
PENNSYLVANIA
FIGURE 1
REGIONAL VICINITY MAP
SCALE 1:24000
N


original ground line
Scales: 1" = 1'-0" hor.
1" = 1'-0" vert.
PROFILE on ℄ of DAM
(LOOKING UPSTREAM)
PLAN of DAM
SECTION



Spillway 60' wide
Top of Dam El. 260
original ground line
Rock Surface
on ℄ of PROPOSED DAM
Slope 2:1
Earth Fill
Earth Fill
CROSS SECTION of DAM at MANHOLE
Flow
Solid Rock Sidewall for Spillway
40 Spillway 8' high
Stone Retaining wall
Flow
LOCATION PLAN
PA
NJ
N
36" Concrete Base
DETAIL at BASE of CORE WALL
Stone Retaining wall
SECTION B-B at SPILLWAY
EARTH DAM with STEEL CORE
AND
NATURAL ROCK SPILLWAY
FOR
LOWELL M. BIRRELL, ESQ.
LOCATED AT
NEW HOPE, BUCKS CO., PENNA
CAMPBELL BATES WHELL CO.
Scale
Date
DRAWING No. 1

FIGURE 2

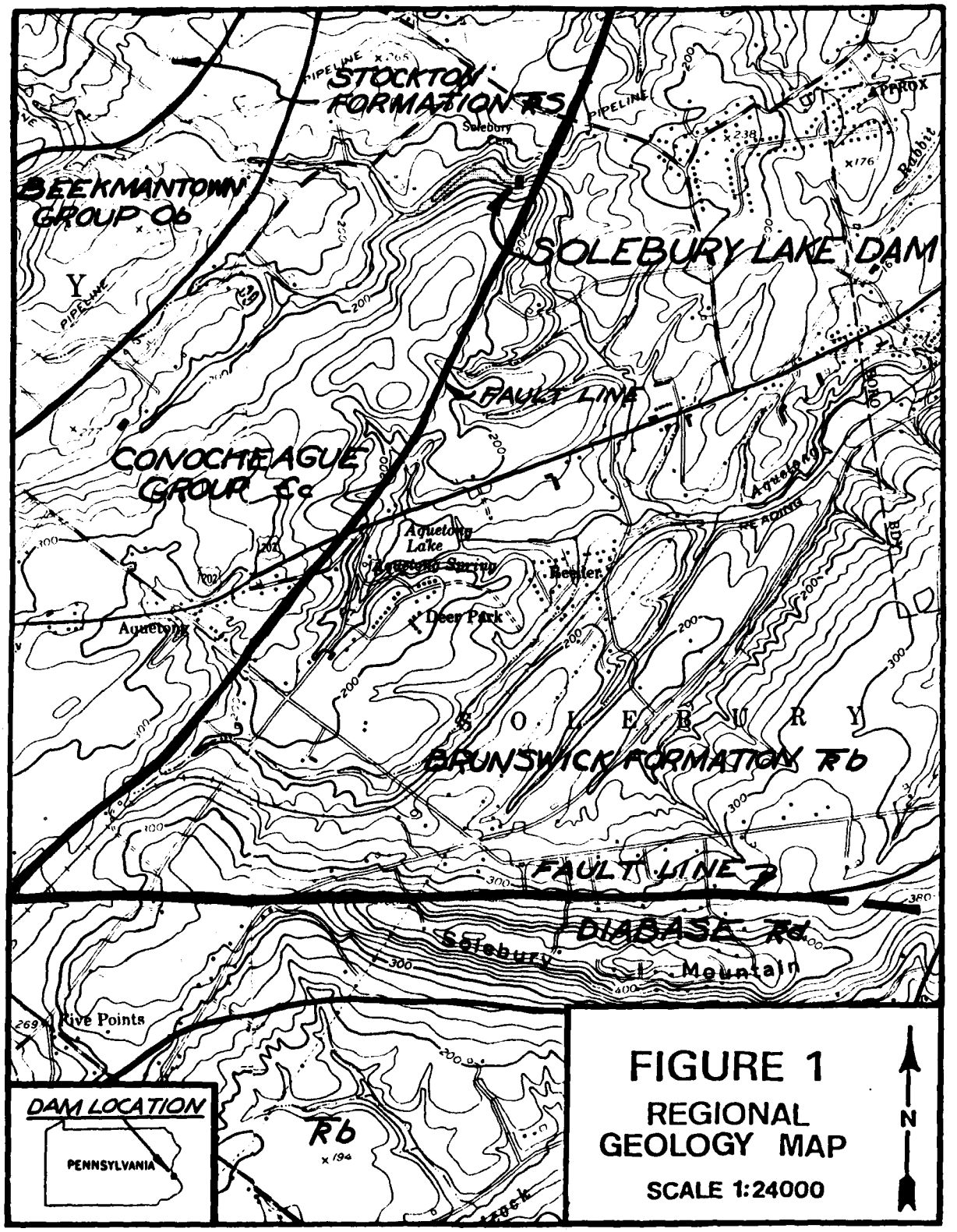
APPENDIX F

GEOLOGY

SITE GEOLOGY

SOLEBURY LAKE DAM

Solebury Lake Dam is located in the Lowland section of the Piedmont Physiographic Province. As shown in Figure 1, bedrock at the damsite is composed of a Cambrian linestone known as the Conscocheague formation. The formation consists of limestone interbedded with thick, massive dolomite. The apparently inactive Furlong fault is located about 250 feet downstream of the dam and is thought to be associated with the Triassic uplift of the Appalachian Mountains.


STOCKTON FORMATION Rs
BEEKMANTOWN GROUP Ob
SOLEBURY LAKE DAM
FAULT LINE
CONOCHEAGUE GROUP Ec
Aquetong Lake
Aquetong Spring
Deer Park
Aquetong
Keeler
SOLEBURY
BRUNSWICK FORMATION Rb
FAULT LINE ?
DIABASE Rd
Solebury
Mountain
Rb
Five Points
DAM LOCATION
PENNSYLVANIA
FIGURE 1
REGIONAL GEOLOGY MAP
SCALE 1:24000
N


DAT
FILM